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Orbital coloniality: satellite constellations and their geopolitical and environmental impacts

Colonialidad orbital: constelaciones de satélites y su impacto geopolítico y medioambiental

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RENATO GUIMARÃES FURTADO[1]
https://orcid.org/0000-0003-3656-9832

This article explores orbital coloniality, a process through which nations and private corporations dominate Earth's orbit, replicating structures of historical colonialism. Satellite constellations operated by US corporations materialize colonial dynamics, economically exploiting and geopolitically controlling space. The study critiques the logic of coloniality underlying US space activities, practices that perpetuate historical inequalities and generate environmental impacts both on Earth and in the cosmos.
KEYWORDS: Orbital coloniality, vertical mediation, vertical hegemony, media infrastructures.

Este artículo explora la colonialidad orbital, un proceso en el que naciones y empresas privadas dominan la órbita terrestre, reproduciendo estructuras del colonialismo histórico. Las constelaciones de satélites propiedad de empresas estadounidenses materializan dinámicas coloniales, explotando económicamente y controlando geopolíticamente el espacio. El estudio critica la lógica de colonialidad subyacente a las actividades espaciales estadounidenses, prácticas que perpetúan las desigualdades históricas y generan impactos medioambientales tanto en la Tierra como en el cosmos.
PALABRAS CLAVE: Colonialidad orbital, mediación vertical, hegemonía vertical, infraestructuras mediáticas.

Este artigo explora a colonialidade orbital, um processo no qual nações e empresas privadas dominam a órbita terrestre, reproduzindo estruturas do colonialismo histórico. As constelações de satélites pertencentes a empresas americanas materializam dinâmicas coloniais, explorando economicamente e controlando geopoliticamente o espaço. O estudo critica a lógica da colonialidade subjacente às atividades espaciais americanas, práticas que perpetuam as desigualdades históricas e geram impactos ambientais tanto na Terra quanto no cosmos.
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[1] Universidade do Estado do Rio de Janeiro, Brazil.
renatogfurtado.34@gmail.com
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Introduction

The final frontier. That is how Americans metaphorically define outer space, a rhetorical construct that guides the behavior, understanding, and imagination of space exploration by the United States and its allies. This metaphor extends terrestrial frontierism to the cosmos, a doctrine that rhetorically justified frontier exploration as the driving force behind the founding of the United States, a nation of conquerors who overcame the challenges of the Old West and triumphed over the wilderness (Treviño, 2020).

When frontierism is applied to outer space, it perpetuates the colonial logic of territorial occupation that characterized the colonization of North America, framed as *terra nullius*: no man's land. This epistemological and ontological structure, materialized under the pretext of progress and development, caused not only ecological destruction but also the genocide of Native American peoples. Cosmic frontierism thus reduces all modes of existence and knowledge about outer space to those imposed by terrestrial capitalism and colonialism (Treviño, 2020), updating and exporting historical practices of oppression, violence, and domination.

This theoretical research analyzes how space exploration, in its colonial orientation, is neither a neutral nor a purely scientific activity, but rather an endeavor that reflects and reproduces the power dynamics of historical colonialism. This phenomenon will be examined in the course of this research using the concept of "orbital coloniality", the process of updating colonial dynamics of occupation and oppression in low Earth orbit (LEO). To this end, it will analyze how the socio-environmental impacts caused by mega-constellations of satellites run by US corporations add to orbital coloniality, consolidating the hegemony of state and corporate actors over finite orbital regions.

The approach integrates perspectives from political science, law, international relations, sociology, and, of course, media studies. The multiplicity of sources is justified because, according to Waisbord (2019), communication is a fragmented, plural, and interdisciplinary discipline *par excellence*. The strength of this field lies in its ability to provide researchers with an analytical space for cross-cutting encoun-

ters, capable of addressing the complexity of reality and its phenomena. Communication is a discipline marked by productive theoretical fragmentation, where diversity of approaches is a resource for thinking about communication as a phenomenon inextricably linked to political, economic, and cultural processes on a global scale.

Therefore, this study proposes a reflection on the impacts of orbital coloniality, emphasizing the need to rethink the narratives and practices that shape space exploration, particularly those endorsed by the United States.

Theoretical-methodological framework

This article uses bibliographic research to analyze the phenomenon of orbital coloniality, adopting a qualitative methodology of a theoretical-critical nature. The analytical procedure is carried out in three main stages: 1) mapping and systematization of the main theoretical references on coloniality, media infrastructures, and vertical hegemony; 2) critical examination of regulatory documents and international legal frameworks, in order to assess how these devices are reinterpreted or violated in the context of mega-constellations, and 3) case study of the Starlink constellation, observing its geopolitical, socioeconomic, and environmental impacts based on the triangulation between scientific literature, technical data, and contemporary events, such as the war in Ukraine. By combining these stages, this article not only theoretically grounds the concept of orbital coloniality, but also empirically examines how vectors of power and exploitation materialize in satellite practices and infrastructures.

Orbital coloniality is a multidimensional process that combines legal, environmental, geopolitical, and symbolic patterns of domination, updating relations of oppression inherited from historical colonialism in the context of space exploration. Orbital coloniality is based on five vectors: the symbolic and material engineering of territories for economic exploitation; the exercise of geopolitical power through territorial control; the violation of international law; environmental impacts; and the rhetoric of progress, which legitimizes the invasion of foreign national sovereignty. It should be emphasized that this does not mean

that these are all the vectors of orbital coloniality; others may and probably will be identified as the phenomenon develops.

The concept of orbital coloniality is an adaptation of the concept of *orbital colonialism* (Jah, 2023). The intention is not to introduce a new term, but to reframe the original concept through the question of coloniality. We have chosen to use "coloniality" rather than "colonialism" because the former term emphasizes the underlying logic of violence and oppression that sustained the socioeconomic, political, and cultural structure of historical colonial regimes. Coloniality legitimizes socioeconomic exploitation and the destruction of natural resources in favor of ideals of development and progress. Thus, while colonialism refers to specific political and governmental systems, coloniality reveals the power structures that persist after the dissolution of formal colonial systems (Mignolo, 2011; Treviño, 2020).

To observe the materialization of orbital coloniality in its five vectors, we analyze the impacts caused by Elon Musk's SpaceX Starlink satellite megaconstellation. The choice of SpaceX as the empirical object in this study is justified by the geopolitical, technological, and symbolic centrality that the company occupies in the context of current space expansionism. SpaceX's actions cannot be understood in isolation from the dynamics of US power projection, which has found in its partnership with the private sector an effective way to sustain its space hegemony (Dy & Roberts, 2024; Stegeman et al., 2018). For the United States, expanding the research and development capacity of private corporations through state investment ultimately means expanding the country's technological, geopolitical, military, and governmental capacity. In this sense, researching SpaceX provides a privileged gateway to understanding the contemporary vectors of orbital coloniality and the ways in which US corporate and state interests underpin the geopolitical and socio-environmental impacts of current space exploration.

For the field of communication, it is essential to expand studies on outer space and the role played by satellites because space is a strategic frontier. Just as control of sea lanes defined political and military power in the past, dominance of the upper atmosphere and Earth's orbit is now central to the struggle for hegemony. The reconfiguration of

global power through space infrastructure –in which satellites play a strategic role– is supported by a rhetoric of development and modernization that obscures understanding of the mechanisms of space power. This infrastructure, under the discourse of technical neutrality, reproduces colonial hierarchies and establishes forms of both symbolic and material domination. In this sense, studying satellites as mediating devices also involves revealing how they act in the production of control over economic, communication, and military flows (Esteinou Madrid, 1987; Mattelart, 1998).

Since the Cold War, space-based information and communication systems have become increasingly important to the global political and economic order. Satellites, among other space technologies, are both tools of power and drivers of innovation. On the one hand, they expand human capabilities; on the other, they reproduce logics of control, extending structures of inequality and geopolitical relations of oppression and domination from Earth to the cosmos. Satellites therefore embody intricate processes of financial investment, military-strategic planning, and advanced research (Parks, 2005; Rico Bovio, 2015) as media devices inseparable from geopolitical disputes on the ground.

It is important to understand satellites as part of a media infrastructure, since infrastructural analysis allows us to address phenomena traversed by the media and communication both from technical and media issues themselves, as well as in their political, economic, and social aspects, especially when the interests of private corporations conflict with the agendas of nation-states and civil society. Media infrastructures are therefore inseparable from geopolitical dimensions, disputes over hegemony, and power relations (Arredondo Ramírez, 2020; Bizberge & Mastrini, 2024; Prato et al., 2022).

In this study, we focus specifically on media infrastructures: socio-technical systems designed to support, enable, and facilitate the distribution and traffic of audiovisual signals and data. In infrastructural terms, observing the processes of media content distribution must also mean analyzing the materialities involved in these practices, that is, the natural resources, technologies, forms of work, and political, economic, and social relations that shape, energize, and sustain media infrastructures (Parks & Starosielski, 2015).

Media infrastructures alter and are altered by economic, cultural, and geopolitical relations, and they also cause significant changes in the human relationship with nature. This is particularly evident, as Parks (2018) demonstrates, in the ways in which the United States uses satellites to ensure its vertical hegemony: dominance over the subsoil, airspace, spectrum, and Earth's orbit. Achieving vertical hegemony requires control of this expansive domain, which amplifies terrestrial power. Challenging or maintaining this domain depends on understanding its profound influence on the Earth.

To obtain or perpetuate vertical hegemony, it is necessary to undertake vertical mediation strategies, that is, the material processes through which media infrastructures materialize control over vertical domains. In this scenario, considering how aggressive US aerospace policies aimed at maintaining vertical hegemony have strained global dynamics, it is essential to understand how vertical mediations reinforce terrestrial operations of domination. In the United States, for example, close collaboration between federal agencies and transnational corporations, such as the partnership between the National Reconnaissance Office (NRO) and Google, increases the state's capacity to extract information and blurs the distinctions between governmental, military, and civilian activities, especially in the cosmic domain (Parks, 2018).

Finally, it is important to emphasize that we do not intend to analyze every proposal for a satellite constellation nor argue that they are all inherently colonialist. Rather, the article aims to analyze how US corporations, such as SpaceX, which is directly funded by the United States government (Garver, 2022), reproduce the logic of coloniality in space exploration. We do not intend to exhaust the critical consideration of satellite mega-constellations because that would involve considering initiatives such as those of China and the European Union. It is important to continue the studies carried out here, especially in a context in which the Chinese space program is progressively challenging US hegemony in the aerospace sector (Milwood, 2023). It is not our objective, therefore, to determine whether China's mega-constellation satellite operations, for example, reproduce the logic of coloniality.

It should also be emphasized that we do not deny the technological benefits of the systems referred to. By providing Internet connectivity

to populations affected by lack of access, these infrastructures can promote various social and economic benefits. As theorists such as van Dijk (2017) point out, digital inclusion facilitates job searching, social networking, participation in community associations, access to information and entertainment, as well as access to public health, and educational services.

Finally, it is necessary to highlight the limitations of this study, as it has been conducted primarily from a theoretical and documentary perspective. This means that, in order to fully observe the phenomenon of orbital coloniality, further research based on empirical analysis will be necessary in the future. The aim is not to exhaust the subject or propose a definitive examination, but rather to contribute to broadening the debate.

Orbital colonialism

Orbital coloniality, or orbital colonialism, according to Jah's original conception (2023), is the process of domination over Earth's orbit following patterns similar to the procedures of territorial occupation that took place during historical colonialism on Earth. Of particular interest here are the ways in which satellite mega-constellations give the United States increasing control over orbit.

This territorial conquest is a consequence of patterns of occupation of Earth's orbit since the 1960s. Given that this is a physically limited territory, the need soon arose to regulate satellite positioning and transmissions to avoid interference and collisions between satellites. Thus, the International Telecommunication Union (ITU) stipulated that parties interested in exploiting satellite technologies in geostationary orbit (GEO) must formally apply for the use of a channel. The organization would then determine which band the applicant could use (Collis, 2012).

Practice would reveal the flaws in the proposal, which contributed to the colonial appropriation of the GEO orbit. According to Collis (2012), countries unable to explore space in the 1960s argued that the decision only favored those who were already able to explore the cosmos. In practice, outer space was only really accessible to the United

States and the Soviet Union. Finally, in 1973, in response to protests against US hegemony in Earth orbit, the ITU declared GEO orbit a limited natural resource. This effectively separated this orbital belt from outer space for practical and legal purposes.

Another vital document that, paradoxically, reinforced orbital coloniality was the Outer Space Treaty (OST), ratified in 1967. As Collis (2012) shows, the agreement establishes that outer space is the common heritage of humankind, and therefore space activities must be carried out for the benefit of all human beings. However, the interpretation of outer space as a domain free of sovereignty claims reinforced the position of developed countries. Indeed, if outer space was to be a territory open to all exploration activities, in practice it was inevitable that those actors capable of exploring space in the 1960s would do so immediately.

Thus, the means and resources possessed by the United States and the Soviet Union for space exploration established a form of territorial domination similar to that which governs sovereignty on Earth. There was a veiled sovereignty over GEO orbit, despite international regulations, established technologically and materially above all by the United States (Collis, 2012). This scenario has been updated in the contemporary era through orbital coloniality, with two of its vectors playing a leading role: geopolitical control and the violation of international law.

Although the LEO can accommodate more satellites than the GEO orbit, it also has physical limitations. As in the Cold War, orbital occupation today is basically secured by the positioning of satellites, so that the mere presence of the device guarantees virtually inalienable ownership of the occupied orbital portion. As most satellites in LEO are American, especially Starlink, geopolitical tensions are heightened. On the one hand, the number of American satellites in LEO prevents the launch of new ones; on the other, it jeopardizes existing orbital assets, such as the Chinese Space Station, which nearly collided with a Starlink satellite in 2021 (Jah, 2023).

At that time, China sent a statement to the United Nations invoking Article VI of the OST, which stipulates that all nation-states must ensure that their activities do not interfere with those of others. Article VI is significant because it explicitly states that nation-states are responsible for their own activities, as well as for the operations of private companies

based in their territory. In this sense, China's statement serves as both a rebuke and a warning, highlighting how the technological race in space can have serious consequences (Milwood, 2023).

The violation of international law is compounded by the actions of the US Federal Communications Commission (FCC), which regulates the operation of US mega-constellations . The occupation of Earth's orbit by US corporate infrastructure is effectively guaranteed by a regulatory body that disregards the OST. Ultimately, it should be emphasized that outer space must be freely available for use by all of humanity and therefore cannot become the territory of any nation. By unilaterally allowing the irregular and unbridled occupation of orbit, the FCC violates Article VI and the principle of due regard, treating LEO as if it were sovereign territory of the United States (Byers & Boley, 2022).

In the case of the United States, the exercise of orbital coloniality is therefore directly related to the quest to maintain its vertical hegemony. As Bowen (2020) points out, occupying orbit also means limiting the region. Control of a portion of orbit allows an agent to restrict the scope of action of its competitors, including reducing the adversary's ability to generate revenue from its space infrastructure. Therefore, satellite constellations also operate as instruments of economic dispute through the physical regulation of the LEO. Thus, according to Jah (2023), passive or tacit occupation of orbit constitutes an implicit claim of ownership –so that the OST is not formally violated– which reinforces orbital coloniality.

The appropriation of territory to exploit economic and political advantages is a constant in the history of colonial power regimes, sustained by dynamic partnerships between nations and corporations. In the context of US space activities, the intertwining of government and aerospace companies occurs primarily through contracts signed with companies such as SpaceX. These corporations invest in the Internet market through mega-constellations of satellites, promising to eradicate the digital divide and increase the individual freedoms of citizens around the world. In practice, however, the rhetoric of the common good, another constant in the logic of coloniality, ensures exclusive political rights and economic privileges for colonialists (Garver, 2022; Utrata, 2024).

The geopolitical impacts of this economic and technoscientific expansion of orbital coloniality can already be seen, for example, in the war in Ukraine. Elon Musk's SpaceX involvement in the Russia-Ukraine conflict embodies the colonial process in space through the rhetoric of progress, inseparable from the ways in which Ukrainian digital sovereignty has been undermined.

First and foremost, it is important to consider that SpaceX's operations are inseparable from the US government's aerospace agenda, not to mention Elon Musk's direct involvement at the start of Donald Trump's second presidential term. Founded in 2002, Musk's company actually operated for only one year with funds coming exclusively from his personal fortune. In 2003, the company received an $8 million government investment to develop the Falcon 1 rocket. Three years later, it obtained $ 278 million through a state incentive program for private sector development. This investment enabled the research and development of the Dragon capsule, as well as the launch of the Falcon 9 project. Today, the corporation is one of the main service providers for NASA, as well as for the Air Force and the Pentagon (Garver, 2022).

For the US government, the technological innovations of corporations such as SpaceX reinforce its state capacity for power projection. The reuse of rockets and the possibility of launching increasingly smaller satellites currently constitute a strategic military advantage in hindering –and even neutralizing– the adverse use of anti-satellite weapons. This logic also applies to specific devices and technologies: SpaceX's Falcon Heavy rocket, for example, was designed to carry enough cargo to place multiple military satellites into orbit (Garver, 2022). The exponential growth in wealth associated with the space programs of individuals such as Musk can be explained by the ways in which the US government promotes the techno-scientific development of private infrastructure as a resource to further its own geopolitical and military interests.

It is in this context –in which Musk's aerospace corporation simultaneously operates more than 7 850 satellites (Pultarova, 2025)– that SpaceX became involved in the war between Russia and Ukraine. At the start of the fighting, Ukrainian digital networks were disrupted by Russian attacks, leading Ukraine to resort to Starlink satellites to restore its communication capabilities, even benefiting the army, which

used digital means to coordinate attacks against the Russians (Manhães & Vilar-Lopes, 2023). Although Ukrainians found immediate benefits in using the Internet via Starlink, the development of the conflict, in terms of communications, simply forced Ukraine to rely even more on private and Western orbital infrastructure, since the country does not have its own satellite capacity, which directly jeopardizes Ukraine's ability to exercise its digital sovereignty.

This refers to the ability of a nation-state to control and make decisions autonomously in relation to data, technologies, and digital infrastructure. However, when the exercise of this form of sovereignty is undermined, it means that we are facing a scenario of digital colonialism: external domination of software, hardware, and means of connection. Thus, as soon as private companies establish what types of devices and infrastructure should or should not be adopted in national contexts, they acquire vast political, economic, and social power (Guerra González et al., 2022).

The dissolution of Ukraine's digital sovereignty, therefore, constitutes US orbital coloniality because it expands their capacity for vertical mediation through its private corporations. Thus, Ukraine, in the context of the war, did not at any time exercise effective vertical mediation, as SpaceX's operations reinforced the projection of US vertical hegemony and, consequently, orbital coloniality through digital colonialism.

The progressively nationalist tilt of the United States under Trump in the face of China's rise has an impact on the geopolitical chessboard of outer space. The anti-multilateralist tendency of the United States denies the recognition of the cosmos as common territory, solidifying the privatization of space. This movement aims to expand the benefits reaped by Washington and its aerospace corporations (Milwood, 2023). The vertical hegemony of the United States, in the context of orbital coloniality, gains strength by causing collateral impacts at the geopolitical and economic levels for the international community.

We must also examine the last two vectors of orbital coloniality: the engineering of territories and environmental impacts. One of the main factors demonstrating the continuity between orbital coloniality and historical colonial regimes is the engineering of territories. This

is the practice whereby state and corporate powers, operating jointly, undertake technological innovations and discursive constructions to appropriate a territory. The first phase of this engineering transforms the territory into no man's land, and subsequently, its occupation constitutes it as private property intended for economic and political exploitation (Tavares et al., 2021; Utrata, 2024).

In the context of orbital coloniality, the satellite operations of corporations such as SpaceX act colonially through the engineering of orbit. The veiled claim of sovereignty over a physical region that should be the common heritage of humanity through direct occupation and economic exploitation shows how US space activities are inseparable from colonial structures. After all, nearly two-thirds of all satellites in orbit are owned by SpaceX (Windsor, 2025). The logic of coloniality therefore underpins US space exploration, creating a context in which historical practices of territorial and economic domination are not only repeated but updated.

In this sense, as Utrata (2024) argues, it is essential to question the notion that the cosmos, despite being devoid of indigenous populations, is simply *terra nullius*. The territorial conception of outer space as a frontier to be conquered is not a natural fact, but a conceptual invention –a territorial engineering– intended to guarantee territorial sovereignty in order to extract geopolitical and economic advantages. Questioning the rhetoric and practices of orbital coloniality paves the way for imposing epistemological limits on the exercise of political, economic, cultural, and technological power by the United States and its transnational corporations.

Contrary to hegemonic rhetoric, there is no single way of relating to space, as demonstrated by indigenous traditions that maintain cultural and sacred relationships with the cosmos, the moon, the sun, and other celestial bodies. In these ways of relating to outer space, the idea of private property is absurd. Such perspectives are weakened, however, by another US norm: the SPACE Act of 2015, a law that enabled private corporations to extract space resources. In this sense, the law exploits loopholes in the OST, arguing that it only prohibits private ownership by nation-states, not private companies (Tavares et al., 2021; Utrata, 2024).

Therefore, examining infrastructure means analyzing power relations. The question of service or exclusion from infrastructure –accessibility, cost, functionality, efficiency, and scarcity– depends not only on the technology itself, but also on the political, social, economic, cultural, and environmental forces mobilized by and around it. The promises of modernization and progress resulting from infrastructural development serve to materialize the discourse of progress (Anand et al., 2018). In the practice of orbital colonialism, however, the pioneers of LEO do not contribute to development or universal connectivity because they are mere colonizers who devastate the territory by preventing its use, transforming their technologies and infrastructures into the only viable options. The operations of satellite mega-constellations, in this sense, are deliberately obscured by the promises of the rhetoric of progress –or digital inclusion, in this case. To highlight their impacts, it is necessary to refer to the considerations of studies on critical infrastructure (Parks & Starosielski, 2015), which denounce how infrastructure operations conceal the political and economic processes that sustain them.

As media infrastructures, satellite mega-constellations reveal and conceal, depending on the perspective taken, a whole series of complexities. According to Parks and Starosielski (2015), media infrastructures are, on the one hand, highly technical and autonomous systems, located in remote places far from public attention, operating in an almost invisible manner. On the other hand, they are apparatuses of power that actively and concretely reconfigure territories, temporalities, and practices, depending on land, raw materials, and energy. Infrastructures are inseparable from geopolitical and environmental repercussions and problems.

As Miraux (2022) has demonstrated, orbital congestion caused by the United States stimulates the Kessler syndrome. This is a hypothetical scenario in which a cascade of collisions caused by impacts between space objects could generate so much debris that it would make Earth's orbit virtually inaccessible to humans. Rendered useless for human purposes due to the immense amount of debris, the inability to explore Earth's orbit would jeopardize the provision of services essential to

contemporary societies, such as geolocation, communication, weather forecasting, and environmental monitoring.

According to data collected in February 2025, there are approximately 13 660 satellites in space, but not all of them are active; more than 2 000 of them are no longer operational or have fragmented (European Space Agency, 2025). Given that the relative speed of a satellite is very high, averaging around 15 kilometers per second, any type of collision between space objects and debris can lead to catastrophic events, increasing the amount of space debris in orbit, as collisions can create more fragments and debris. Although satellite operators apply evasive maneuvers and preventive measures, there is a permanent risk of collisions in orbit (Miraux, 2022).

Although the Kessler syndrome hypothesis may sound extreme, the facts indicate that the situation is rapidly worsening. Large-scale orbital collisions have been a tangible reality since 2009, when the Russian satellite Cosmos 2251 collided with the American satellite Iridium 33; the two objects, traveling at over 15 000 mph, generated a huge cloud of debris (Parks, 2012). Furthermore, according to the US Federal Aviation Administration (2023), the number of collision alerts between satellites within a five-kilometer radius increased from 210 per week in 2014 to approximately 60 000 in 2021. Of these nearly 60 000 alerts, 40% involved Starlink satellites.

Furthermore, the re-entry of satellites into the Earth's atmosphere introduces polluting materials, particularly aluminum, which reacts directly with oxygen. As a result, aluminum oxide nanoparticles, that can persist in the atmosphere for decades, are produced, contributing to the destruction of the ozone layer. In 2022, satellite re-entries caused a 29.5 % increase in atmospheric aluminum levels, injecting at least 17 metric tons of aluminum oxide into the mesosphere. Scientific simulations predict that when all the mega-constellations currently under construction are fully operational, the continuous re-entry of these objects could release 360 metric tons of aluminum oxide annually. Considering the Starlink megaconstellation in its maximum projected configuration of nearly 35 000 satellites in operation, 23 satellites –equivalent to 29 tons of metal– from Elon Musk's company will re-enter the Earth's atmosphere daily (Ferreira et al., 2024; Gaston

et al., 2023; Gutterman, 2024).

Thus, in the context of orbital coloniality, threats to the sustainability of Earth's orbit stem directly from the colonialist perspective of (supposed) human superiority over nature, which legitimized the exploitation of the non-human world, ignoring the resulting environmental impacts. As decolonial philosopher Treviño (2020) argues, the rhetoric of space frontierism mirrors colonial strategies of domesticating nature on Earth. Thus, the ideal of the final frontier reproduces structures of colonial oppression by ignoring the ecological and ethical costs of space frontierism, perpetuating cycles of irreversible exploitation and destruction.

These narratives not only ignore geopolitical realities and the suffering of humans and non-humans, but also eminently material factors, both technological and geographical. The LEO is physically incapable of supporting an infinite number of satellites, so the uncontrolled launch of objects in this range tends to cause the collapse predicted by Kessler syndrome. At the same time, physical collapse is accompanied by the geopolitical collapse of the commons, because lack of cooperation –which violates the fundamental principles of the OST– leads to a form of space exploration that increases the likelihood of conflict and harm to the international community (Bowen, 2020; Milwood, 2023). This, in turn, can lead to further environmental impacts and so on, in a vicious circle.

For this reason, reclaiming a commitment to the principles enshrined in the OST would be a fundamental step against orbital coloniality, as it allows space law to be connected to environmental law. According to Milwood (2023), the precept of due consideration for the activities of third parties in outer space can be more than just a mechanism for dialogue and precaution to guarantee and guide the freedom of exploitation of each agent. It could be a means of extending the precautionary principles of international environmental law to the cosmos. However, a major problem is that outer space is not legally understood as a natural environment, like nature itself, and therefore does not necessarily need to be protected from pollution or the impacts of human activities; what needs to be protected, according to the OST, are the activities of space actors.

The principle of due consideration could also serve as the basis for international agreements aimed at establishing rules for the launch of space cargo, whether by nation-states or transnational corporations. This would not only regulate the issue of orbital congestion more strictly, but could also help reduce the risks associated with the re-entry of satellites and rocket parts, for example, a problem that disproportionately affects low-income populations in the Global South. Cooperation to find technological solutions to collective environmental problems is a viable and effective avenue, as demonstrated by international treaties that have established parameters for the protection of the ozone layer (Byers & Boley, 2022).

The principle of due consideration may also be important in curbing orbital coloniality because it has an inherent ethical dimension. As Milwood (2023) explains, this precept dictates that any activity must be carried out in such a way as to avoid unacceptable and irreversible damage to human life and health, caused without regard for the human rights of those affected and the sustainability of future generations. Thus, given that mega-constellations of satellites directly threaten the space operations of other actors –including nation-states such as China–, tend to increase debris in LEO, and may contribute to the degradation of the ozone layer, it is more than plausible to argue that US satellite operations violate the principle of due consideration, both logistically and ethically.

On the one hand, the US allows the unrestrained launch of satellites through its transnational corporations, ignoring the activities of other nations and actors without even consulting them and the environmental impacts caused by mega-constellations (Milwood, 2023), especially in terms of orbital congestion. On the other hand, such infrastructures, by occupying the LEO, physically limit the access of other nations and actors to what should be common territory. Thus, as long as the LEO is not recognized as a finite resource, like the GEO orbit, the trend is for the race to occupy these orbital bands to reproduce colonial patterns.

In summary, orbital coloniality reflects the persistence of colonial dynamics in space, driven by technological disparities, regulatory gaps, economic and political territorial control operations, and an anthropocentric stance that ignores the damage caused to nature and human health in favor of progress and development.

Conclusion

Orbital coloniality not only reflects but also updates traditional colonial dynamics. The concept of *terra nullius* is reapplied to space, transforming it into a new frontier for economic and political extraction. Corporations such as SpaceX, supported by hegemonic governments such as that of the United States, employ universalist narratives –such as the supposed global benefits of Internet connectivity– to justify exclusionary practices. As a result, outer space becomes the scene of disputes over infrastructural sovereignty, where technologically advanced actors impose their norms and interests.

This phenomenon represents an extension of the oppressive logics that characterized historical colonialism, now projected into outer space. The mega-constellations operated by US-based companies exemplify how neocolonial practices persist beyond Earth. By prioritizing specific economic and geopolitical interests, these initiatives marginalize less privileged communities and jeopardize environmental sustainability both on Earth and in space.

Satellite mega-constellations generate significant geopolitical and socio-environmental impacts by consolidating the dominance of technologically advanced actors over finite regions of Earth's orbit, reinforcing power asymmetries between nations and deepening inequalities in access to digital infrastructure. On the geopolitical level, the massive occupation of low orbit by companies such as SpaceX limits the ability of other states to launch or operate satellites, creating a form of covert infrastructural sovereignty that calls into question the principle of space as the common heritage of humanity.

At the socio-environmental level, the excessive launch of these devices intensifies the production of space debris, increases the risk of catastrophic collisions, and threatens to compromise essential functions such as geolocation, climate prediction, and global communication. In addition, uncontrolled re-entries of space debris disproportionately affect regions of the Global South, exposing vulnerable populations to unfair environmental risks.

To address these challenges, a new approach to space governance is urgently needed, one that prioritizes equity, precaution, and multilateral

collaboration. This includes limiting the transnational actions of national regulatory bodies such as the FCC and promoting international agreements that reinforce the principle of space as a shared heritage. Only with these measures will it be possible to break with the colonial logic that permeates current space expansionism and build a more just and inclusive future.

The absence of an updated international regulatory framework amplifies the problems associated with orbital coloniality. Although the OST was pioneering in its day, it is proving insufficient to address modern challenges, such as the proliferation of mega-constellations. Furthermore, environmental considerations continue to be overlooked in space legislation. Proposals inspired by successful international treaties, such as those protecting the ozone layer, could lay the foundations for more equitable and sustainable governance.

Rejecting the continuation of colonial and capitalist logic is essential, because the future existence of humanity depends entirely on how we navigate the present. If colonial modes of existence are insisted upon, these patterns will inevitably be exported into space, perpetuating oppression both on Earth and beyond. Given the power of the colonial system in shaping the contemporary world, it is imperative to prevent such structures from continuing to reproduce in the context of space expansionism. The current trajectory points alarmingly toward a repetition of the injustices and oppressions that have marked both the past and the present, projecting them into the future (Tavares et al., 2021).

Faced with such an urgent task, we hope to have contributed, even if only partially, to revealing and criticizing the context of orbital coloniality.

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Curriculum vitae

Renato Guimarães Furtado
Master's degree and PhD candidate in Communication from the State University of Rio de Janeiro (UERJ). Film critic trained by the Berlin International Film Festival (Rio de Janeiro, 2016). Researches topics such as satellites, artificial intelligence, infrastructure, and the geopolitics of communication, cinema, and the climate crisis.